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INT.CL. : C22C 21/12

TITLE : ALUMINUM ALLOY FOR HIGH PRESSURE CASTING HAVING SUPERIOR STRENGTH

ABSTRACT : PURPOSE: To eliminate defects caused by segregation, blowholes, inclusions, etc., in high pressure casting and to give superior strength by providing an Al alloy containing specific amounts of Si, Cu, Mn and Mg as principal components.

CONSTITUTION: The alloy has a composition consisting of 0.2~1.0% Si, 1~5% Cu, 0.3~1.2% Mn, 0.3~2.0% Mg, and the balance Al with impurities, to which 0.005~0.2% Ti and 0.0005~0.05% B are incorporated, if necessary. The Al alloy is subjected to high pressure casting under a pressure of about 300~3,000kg/cm^2. This cast Al alloy excels in strength, toughness, isotropy of mechanical properties, etc., so that it can be used for automobile parts and electronic machine-relating parts.

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⑫公開特許公報（A）　　昭61－227146

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審査請求　未請求　発明の数 2 （全2頁）

㊹発明の名称　強度のすぐれた高圧鋳造用アルミニウム合金

㉑特　願　昭60－68046

㉒出　願　昭60(1985)3月29日

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明細書

1. 発明の名称

強度のすぐれた高圧鋳造用アルミニウム合金

2. 特許請求の範囲

(1) Si 0.2～1.0%，Cu 1～5%，Mn 0.3～1.2%，Mg 0.3～2.0%を含み、残部アルミニウムおよび不純物からなる強度のすぐれた高圧鋳造用アルミニウム合金。

(2) Si 0.2～1.0%，Cu 1～5%，Mn 0.3～1.2%，Mg 0.3～2.0%，Ti 0.005～0.2%，B 0.0002～0.05%を含み、残部アルミニウムおよび不純物からなる強度のすぐれた高圧鋳造用アルミニウム合金。

3. 発明の詳細な説明

産業上の利用分野

この発明は高圧鋳造用アルミニウム合金、とくに強度と靱性を有する高圧鋳造用アルミニウム合金に関する。

従来の技術

従来、自動車ホィールなどの自動車部品、VTRシリンダー、あるいはスピンドルバルブ、アクチュエーター、サポートなどの外部記憶装置の部品としてはアルミニウム合金の鋳物やアルミニウム合金の鍛造材を切削加工したものが使用されているが、鋳物材は一般に~~偏析~~（収縮巣）、介材物、酸化物による欠陥が多く、強度の面で信頼性に欠けるとともに、電子関連部品として使用した場合には例えばVTRの映像が乱れたり、記憶装置の作動に支障を来すなどの問題がある。

鋳物用アルミニウム合金として広く用いられている（合金は一般の鋳造法で湯流れ性、収縮巣、鋳造割れの鋳造欠陥を防止することを優先して合金成分が積成されていることが多く、性能の面で展伸材、鍛造品に劣り）~~Siを含むAl－Si系合金は鋳造組織中のSiの初晶粒子が大きくなり易く、その分散も不均一となりやすいため耐摩耗性に問題があり~~、また鍛造材はコスト高となる難点がある。

発明が解決しようとする問題点

この発明は上記従来の問題を解決し、偏析、巣、介在物などによる欠陥がなく、強度、靱性、耐摩耗性にすぐれ、機械的性質の等方性にもすぐれた（鍛造品に相当する性能を有する）高圧鋳造用アルミニウム合金を提供するものである。

問題点を解決するための手段

この発明は、Si 0.2～1.0%，Cu 1～5%，Mn 0.3～1.2%，Mg 0.3～2.0%を含み、残部Alおよび不純物からなる高圧鋳造用アルミニウム合金およびSi 0.2～1.0%，Cu 1～5%，Mn 0.3～1.2%，Mg 0.3～2.0%，Ti 0.005～0.2%，B 0.0002～0.05%を含み、残余アルミニウムおよび不純物からなる強度のすぐれた高圧鋳造用アルミニウム合金を要旨とするものである。

好ましい組成としてはSi 0.85～1.0%，Cu 3.5～4.5%，Mn 0.4～1.0%，Mg 0.45～1.0，Ti 0.01～0.15%，B 0.001～0.005残部アルミニウムおよび不純物からなる特許請求の範囲第2項記載の強度のすぐれた高圧鋳造用アルミニウム合金である。

以下成分添加元素の限定および組成限度の理由について説明する。

Si：Mgと共存して強度向上に役立つ成分であるが、0.2%より少いと効果が小さく、1.0%を越すと伸び、靭性を低下させる。0.3～0.80%の範囲で添加するのが好ましい。

Mg：Siと共存して強度向上に役立つが、0.3%より少いと効果が小さく、1.2%を越えると伸び、靭性を低下させる。0.8～1.2%の範囲で添加するのが好ましい。

Cu：Mgと共存して強度向上に役立つ。1%より少いと効果が少く5%を越えると伸びと靭性を低下して好ましくない。

Mn：耐食性、耐応力腐食性、靭性を向上させる効果があるが、この場合1.2%をこえると伸びと靭性を低下し、0.3%以下では強度向上効果が少ない。

Ti，B：Tiは微量のBと共存して鋳造組織を微細化する。高圧凝固鋳造の欠点であるマクロ偏析防止に役立つ。それぞれ0.005%および0.0002%より少いと効果が小さく、それぞれ0.2%および0.05%を越えると大きな介在物TiB_2などが生じ、ハードスポット等の発生原因になり靭性、伸びを低下させる。とくにTi，Bを共存させた場合0.01～0.15，B 0.0001～0.005%の範囲で添加するのがより好ましい。Ti単独添加ではTi量が多くなり0.5%に至ると金属間化合物を生ずる欠点がある。製造工程について説明すると、この合金は高圧下で鋳造した場合に鋳造欠陥をなくし、所期の性能が得られる。加圧条件としては300～3000kg／cm²が好ましい。この圧力より低いと収縮巣や割れが発生し易い。またこの限界をこえて高圧にしても巣や割れの目的に応じて時効処理などの調質が可能である。

実施例

下表に示すアルミニウム合金を圧力1000kg／cm²で金型に高圧鋳造し長さ100φ×200長さmmの丸棒とし、この丸棒からJIS 4号引張り試験片を切り出して無処理後引張り試験を行った。

No.	成分								
	Si	Fe	Cu	Mn	Mg	Cr	Zn	Ti	B
1	0.41	0.06	4.0	0.63	0.80	0.00	0.01	0.02	0.002
2	0.82	0.10	4.4	0.84	0.45	0.00	0.00	0.03	0.002

No.	熱処理	機械的性質		
		σ 0.2 kg/mm²	σ B kg/mm²	δ %
1	T4	26.8	39.7	12
2	T4	26.0	39.7	10
	T6	37.0	42.3	5

この高圧下で鋳造した発明合金には巣や割れなどの欠陥は見られなかった。一方No.1の合金を大気圧の下で金型鋳造した場合T4処理の結果σ 0.2 24.3 kg／mm² σ B 36.8 kg／mm² δ 5%であった。また断面を検査したところ巣や割れが生じていた。これが延性劣下の原因をなすものと考えられる。

発明の効果

以上のようにこの発明の高圧鋳造用合金は偏析、巣などの欠陥がなく強度、靭性にすぐれており、自動車部品、電子関連部品として適している。

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No. Sho 61[1986]-227146

ALUMINUM ALLOYS WITH EXCELLENT STRENGTH FOR HIGH-PRESSURE CASTING

Yoshinori Kataoka and Yasuo Ofukune

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ALUMINUM ALLOYS WITH EXCELLENT STRENGTH FOR HIGH-PRESSURE CASTING

[Kyodono sugureta koatsuchuzoyo aruminiumugokin]

Inventors:	Yoshinori Kataoka, Yasuo Ofukune
Applicant:	Sumitomo Light Metal Industries Co., Ltd.

[There are no amendments to this patent]

Claim

1. Aluminum alloys with excellent strength for high-pressure casting contain Si 0.2-1.0%, Cu 1-5%, Mn 0.3-1.2%, Mg 0.3-2.0% and the balance of aluminum and impurities.

2. Aluminum alloys with excellent strength for high-pressure casting contain Si 0.2-1.0%, Cu 1-5%, Mn 0.3-1.2%, Mg 0.3-2.0%, Ti 0.005-0.2%, B 0.0002-0.05% and the balance of aluminum and impurities.

Detailed explanation of invention

Industrial application field

The present invention relates to aluminum alloys for high-pressure casting, more specifically to aluminum alloys with strength and toughness for high-pressure casting.

Prior art

Castings of aluminum alloys or cut-processed forged materials of aluminum alloys have been used as automobile parts such as automobile wheel and the like and parts of external memory devices such as VTR cylinders, spindle valves, actuators, supports and the like until now. However, cast materials have many defects, generally, by segregation, shrinkage cavities, inclusions, and oxides, and lack reliability of strength. Further, when they are used for electron-related parts, there arise such problems as disturbances in the VTR image, and hindrance in the operation of memory devices.

Aluminum alloys widely used for cast materials are more often composed of alloy components selected by giving top priority to the prevention of casting defects, such as melt marks, shrinkage cavities, cast cracks, and the like in the general casting process, and the cast materials are inferior in performance to expanded materials and forged products. Further, forged materials have the disadvantage of high cost.

Problems to be solved by invention

The present invention solves the aforementioned conventional problems to provide aluminum alloys superior in strength, toughness, wear resistance and also isotropy of mechanical properties without defects of segregation, blowholes, inclusions, and the like for high-pressure casting.

Means to solve the problems

The purporse of the present invention is aluminum alloys comprising Si 0.2-1.0%, Cu 1-5%, Mn 0.3-1.2%, Mg 0.3-2.0% and the balance of aluminum and impurities for high-pressure casting, and aluminum alloys with excellent strength, and comprising Si 0.2-1.0%, Cu 1-5%, Mn 0.3-1.2%, Mg 0.8-2.0%, Ti 0.005-0.2%, B 0.002-0.05% [sic] and the balance of aluminum and impurities for high-pressure casting.

The preferable composition is aluminum alloys with excellent strength and comprising Si 0.35-1.0%, Cu 3.5-4.5%, Mn 0.4-1.0%, Mg 0.45-1.0%, Ti 0.01-0.15%, B 0.001-0.005% and the balance of aluminum and impurities for high-pressure casting described in claim 2.

Hereinafter, the significance of addition elements and reasons for the composition limit will be explained.

Si: This component coexists with Mg and is used for strength improvement. However, when it is less than 0.2% its effect is small, on the other hand, when it exceeds 1.0%, the elongation and toughness decrease. It is preferred to add it in a range of 0.3~0.80%.

Mg: This component coexists with Si and is used for strength improvement. However, when it is less than 0.3%, its effect is small; on the other hand, when it exceeds 1.2%, the elongation and toughness decrease. It is preferred to add it in a range of 0.3~1.2%.

Cu: This component coexists with Mg and is used for strength improvement. However, when it is less than 1%, its effect is small, on the other hand, when it exceeds 5% the elongation and toughness decrease.

Mn: This has the effect of improving corrosion resistance, stress corrosion resistance, and toughness. However, when it exceeds 1.2%, the elongation and toughness decreases. On the other hand, when it is less than 0.3%, the strength improving effect is small.

Ti, B: Ti coexists with a trace of B and makes the cast structure fine. It is useful for prevention of macrosegregation, which is a drawback in high-pressure solidification casting. When they are less than 0.005% and 0.0002%, respectively, the effect is small. On the other hand, when they exceed 0.2% and 0.05%, respectively, large inclusion TiB_2 and the like form, causing the generation of hard spots and the like and lowers toughness and elongation. Especially, when Ti and B coexist, it is preferred to add those at a range of 0.01~0.15 for Ti and 0.001~0.005% for B. In the case of addition of Ti alone, there is the drawback of forming intermetallic compounds when the Ti content reaches 0.5%. When this alloy is cast at high pressure in the production process, casting defect disappears and desired efficiency is obtained. As the pressure, 300~3000 kg/cm^2 is preferred. When the pressure is lower than the above mentioned range, shrinkage cavities or cracks easily form. Further, even when the pressure exceeds the above pressure limit, it is possible to carry out refining such as aging treatment and the like according to the purpose.

Application example

Aluminum alloys shown in the following table were high-pressure cast in a die at a pressure of 1000 kg/cm^2 in the shape of bars of diameter 100 x 200 mm length, and a JIS No. 4 tensile test piece was cut out from the bar, heat-treated and subjected to a tensile test.

No.	① 成分								
	Si	Fe	Cu	Mn	Mg	Cr	Zn	Ti	B
1	0.41	0.06	4.0	0.53	0.80	0.09	0.01	0.02	0.002
2	0.62	0.10	4.4	0.54	0.45	0.00	0.00	0.03	0.002

No.	②熱処理	③機械的性質		
		σ 0.2kg/mm²	σ Bkg/mm²	δ %
1	T4	24.3	36.7	12
2	T4	24.0	36.7	10
	T6	37.0	42.3	3

Key: 1 Components
2 Heat treatment
3 Mechanical properties

There were no defects such as blowholes, cracks, and the like in the invention alloys cast at high pressure. On the other hand, when No. 1 alloy was cast at atmospheric pressure and heat treated by T4 treatment, $\sigma_{0.2}$ was 24.3 kg/mm^2; σ_B was 36.8 kg/mm^2; δ was 5%. When the cross section was inspected, blowholes and cracks were found. It is thought that they may cause reduction of ductility.

Effect of the invention

As explained above, the present invention alloys for high-pressure casting are superior in strength and toughness without defects such as segregation, blowholes, and the like and are suitable for automobile parts and electronics parts.